FLOWSERVE

USER INSTRUCTIONS

Worcester Controls XCL/XML UltraSwitch™

Switchbox

FCD WCENIM0120-13-A4 - (02/15)

Installation
Operation
Maintenance

Experience In Motion

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1 Introduction

Worcester Controls UltraSwitch™ limit switch enclosures provide local and remote position indication for automated valves. They generally feature a visual indicator with “red=closed” and “green=open” for intuitive local position determination. The UltraSwitch is available with a number of limit switch options for remote indication in a variety of electrical applications. The device may also be used as a junction box for direct installation of solenoid valves.

2 Installation

2.1 Mounting to Actuator

UltraSwitches may be installed to valves or valve actuators with a variety of mounting hardware. For best results, specify the NAMUR shaft option and NAMUR mounting hardware when installing to NAMUR compliant actuator. These options allow direct coupling to actuators without the need to use additional mounting kits, reducing dead band.

Simply bolt the bracket to the actuator and bolt the UltraSwitch to the bracket, leaving the bolts finger tight. For NAMUR applications, the UltraSwitch shaft features an integral alignment pin. This pin must engage the tapped hole in the actuator shaft. For non-NAMUR applications, make sure to properly install a coupler between the UltraSwitch and actuator. Once the UltraSwitch is installed with fasteners loosely tightened, stroke the actuator two or three times to align the bracket, then tighten all fasteners.

2.2 Wiring Instructions

UltraSwitch enclosures feature pre-wired switches. All user connections are made at a numbered terminal strip. Both external bonding and internal grounding locations have been provided for use in installation. A wiring diagram is located inside the cover and indicates which terminal numbers correspond to switch contacts: normally open, normally closed, common, etc. Simply follow the wiring diagram and electric code to connect switches to your system.

For field wiring: ensure that any excess wire lengths or loops are routed away from any moving parts and are short enough, or secured to ensure a ¼” clearance between the wire and the inside surface of the switch box cover.

NOTE: For all magnetically-tripped proximity switches, the top switch (top and third switches for 4-switch versions) should only be used to indicate the clockwise position: the bottom switch (second and fourth switches for 4-switch versions) should only be used to indicate the counter-clockwise position. Any deviation from these settings may result in erratic indication.

Solenoids may also be wired through the UltraSwitch enclosure. At least two auxiliary terminals are included as standard.

A ground screw is also included. Simply wire the solenoid to auxiliary terminals, then connect power leads to the opposite terminal side. Be sure to properly ground the solenoid at provided ground terminal. UltraSwitch XCL series enclosures include two ¾” NPT conduit entries and the XML series includes two M25x1.5 conduit entries. Installation shall be per National Electric Code, local codes, and manufacturers’ instructions.

2.3 Special Hazardous Location Instructions

Connecting cables must be rated for ambient temperatures above 100°C (212°F). Therefore select appropriately-rated cable.

⚠ **WARNING:** To prevent ignition of hazardous atmospheres, conduit runs must have sealing fitting located within 18 inches of the enclosure to meet NEC regulations. See Solenoid nameplate for additional electrical rating.

For ATEX and IECEx installations, an appropriately-rated Cable Gland is required.

In all cases, environmental seals must be used to protect against ingress of water through the conduit.

Any unused conduit entry must have a suitably-rated blanking element.

Modification of the product is not permitted. If equipment is modified, then the equipment can no longer be used in explosive atmospheres.

⚠ **CAUTION:**

- Substitution of components may impair suitability for Zone 2 Increased Safety.
- Do not disconnect equipment unless power has been switched off or the area is non-hazardous. To prevent ignition of hazardous atmospheres, keep unit tightly closed while circuits are live.
- Due to the risk of static electricity, cleaning this housing by rubbing should be done in a non-hazardous area. In this instance, the unit must first be removed and then taken to a non-hazardous area.
- To avoid the risk of potential electrostatic charging hazard, clean only with a damp cloth. All grounding and bonding installation requirements must be in Worcester Controlsance with the governing hazardous location standards corresponding to the specific environment and application the device will be installed in.
- All installation, inspection, and maintenance of the equipment must be performed by trained and authorized personnel. In addition, for equipment certified for use in hazardous areas, all installation, inspection, maintenance and repair must be done by trained personnel.
- Only Flowserve replacement parts must be used in order to not invalidate certification.
- Modification of the product including label and markings is not permitted.

Special Conditions For Safe Use

(see section 8.1 with max safe gaps)

⚠ **CAUTION (specific for different certificates):**

cCSAus EX:

⚠ **CAUTION:** To prevent ignition of hazardous atmospheres, keep unit tightly closed while circuits are live. Disconnect supply circuit before opening.

⚠ **AVERTISSEMENT:** ouvrir le circuit avant d'enlever le couvercle bien ferme' lorsque les circuitssont sous tension.

cCSAus NI:

⚠ **WARNING:** Explosion hazard - substitution of components may impair suitability for class i, division 2.

⚠ **AVERTISSEMENT:** risque d'explosion - la substitution de composants peut rendre ce material inacceptable pour les emplacements de class i, division 2.

⚠ **WARNING:** Explosion hazard - do not disconnect equipment unless power has been switched off or the area is non-hazardous.

⚠ **AVERTISSEMENT:** ouvrir le circuit avant d'enlever le couvercle bien ferme lorsque les circuits sont sous tension.

cCSAus IS:

⚠ **WARNING:** Substitution of components may impair intrinsic safety.

⚠ **WARNING**: To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing. Refer to control drawing x00525c for entity parameters and installation.

ATEX/IECEx/KOSHA Ex d:

⚠ **WARNING:** Potential electrostatic charging hazard, clean only with a damp cloth. Danger of propagating discharge.

⚠ **CAUTION**: To prevent ignition of hazardous atmospheres, keep unit tight while circuits are live. Disconnect supply circuit before opening.

⚠ **AVERTISSEMENT:** ouvrir le circuit avant d'enlever le couvercle bien ferme' lorsque les circuits sont sous tension.

⚠ **WARNING**: Connecting cables must be rated for ambient temperatures above 100°C (212°F). Therefore select appropriately-rated cable.

⚠ **WARNING**: To prevent ignition of hazardous atmospheres, conduit runs must have sealing fitting located within 18 inches of the enclosure. See nameplate for version with solenoid for additional electrical rating.

INMETRO Ex d:

"ATENÇÃO-NÃO ABRA QUANDO ENERGIZADO"

"ATENÇÃO-RISCO POTENCIAL DE CARGA ELECTROSTÁTICA - LIMPE SOMENTE COM UM PANO ÚMIDO"

"ATENÇÃO-UTILIZE CABOS APROPIADOS PARA A TEMPERATURADE 110 ºC"

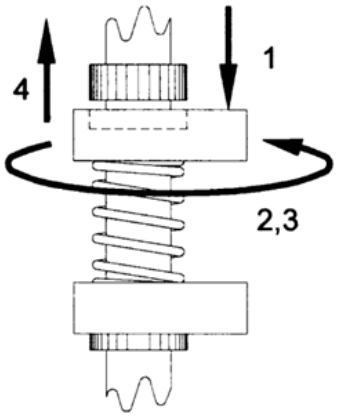
3 Configuring the Unit

3.1 Adjusting Limit Switches

UltraSwitch enclosures feature quick-set cams which are used to trip the limit switches. These cams are easily adjusted without tools.

⚠ **CAUTION**: Disconnect power before removing cover when installed in hazardous locations. Remove cover and set aside. Rotate actuator/valve to full clockwise (CW) position. Adjust cam(s) associated with CW as follows:

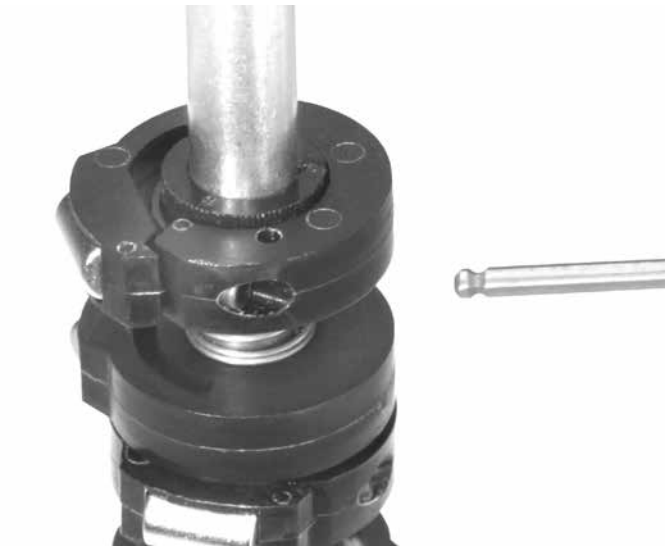
1. Push or pull cam against spring to disengage it from splines.
2. Rotate cam CW, breaking contact with switch (or moving magnet away from switch).
3. Continue rotating cam CW until switch trips.
4. Release cam and reengage it with splines.
5. Rotate actuator/valve to full counterclockwise (CCW) position. Adjust cam(s) associated with CCW as described insteps 1 through 4, except rotate cam(s) CCW.



NOTE: Factory setting is top switch = CW (closed), second switch = CCW (open), third switch = CW, and fourth switch = CCW.

3.2 Cam Fine Adjustment

Some cams have a fine adjustment available. These cams will have a small screw embedded into the side of the cam. Adjusting this screw inward or outward will deform the cam, changing the trip point slightly.

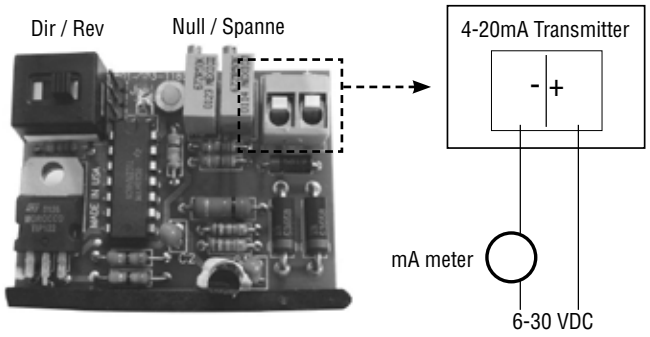


3.3 Adjusting UltraDome Position Indicator

UltraDome visual indicators are easily adjusted to match the dome's clear windows to the rotor's colored sections. The dome is secured to the UltraSwitch housing with screws mounted through slotted holes. The slotted holes allow approximately 20° adjustment of the dome. In addition, the dome can be completely removed and reoriented in 45° and 90° increments. The rotor may be reoriented with respect to the shaft by removing the shaftcoupler and rotating 90° before reinstalling. This may be necessary to obtain the correct orientation of windows in a multi-way application.

3.4 Calibrating 4-20 mA Transmitter

Setting direct/reverse action: A dip-switch marked Dir/Rev on the illustration below controls the direction of increasing travel. For 4 mA in the full clockwise position, select "D," for 4 mA in the full counter clockwise position, select "R."



Adjusting zero/span:

1. Attach a DC mA meter to +/- terminals.
2. Operate valve/switch box to position corresponding to 4 mA.
3. Adjust feedback board zero trim pot to yield 4 mA. (Turning CW increases value, turning CCW decreases value.)
4. Operate valve/switch box to position corresponding to 20 mA feedback.
5. Adjust feedback board span trim pot to yield 20 mA. (Turning CW increases value, turning CCW decreases value.)
6. The zero and span adjustments are interactive. Repeat steps 1 through 5 as necessary.

NOTE: If transmitter adjustment gets difficult (i.e., trim pots do not have desired effect) start over by "centering" the trim pots. This is accomplished by turning in one direction for 20 turns and reversing direction for 10 turns.

4 Specifications

4.1 Switch Option Specifications

Switch Option	Manufacturer	Part Number	Load Capacity
M1 – SPDT Mechanical	Honeywell MicroSwitch	V7-1C13D8-201	15.1A (1/2 HP) at 125/250 VAC; ½A at 125 VDC; 1/4A at 250VDC; 5A at 120Vac
MC – SPDT Mechanical 250°F	Honeywell MicroSwitch	V7-1C13D8-201	15.1A (1/2 HP) at 125 VAC; ½A at 125 VDC; 1/4A at 250VDC; 5A at 120Vac
MG – SPDT Gold Mechanical	Honeywell MicroSwitch	V7-1D19D8-201	1A at 125 VAC / 50 mA at 24 VDC
MA – 3-Position Control	Honeywell MicroSwitch	V7-1C13D8-201	15.1A (1/2 HP) at 125 VAC; ½A at 125 VDC; 1/4A at 250VDC; 5A at 120Vac
M3 – DPDT Mechanical	Cherry	E19-00A	15A, 125/250 VAC 3/5HP
MB – DPDT Mechanical	Licon	22-104	10A (1/2 HP) at 125 VAC
MD – 3-Pos. Control w/Indication (DA)	Licon	22-104	10A (1/2 HP) at 125 VAC
MS – 3-Pos. Control w/Indication (SR)	Licon	22-104	10A (1/2 HP) at 125 VAC
P4 – SPST Proximity	Aleph	PS-6132	0.35A at 140 VAC / .25A at 200VDC (50 W Max.)
P5 – SPDT Proximity	Hamlin	59135-030	0.25A at 120 VAC / 0.25A at 28 VDC (3 W Max.)
PE – SPDT Sabre Proximity	Flowserve	XA0199	1A at 120 VAC / 1A at 24 VDC
PP – SPDT Phazer Proximity	Flowserve	XA0155	3A at 120 VAC / 2A at 24 VDC
PT – SPST BRS Proximity	Flowserve	XA0157	3A at 120 VAC / 0.5 at 24 VDC
N8 – Solid State Proximity	Pepperl + Fuchs	NJ2-V3-N	NAMUR Sensor Output / 5-25 VDC Supply
NP – Solid State Proximity	Pepperl + Fuchs	SJ3.5-N	
NQ – Solid State Proximity	Pepperl + Fuchs	NJ4-12GK-N	
NR – Solid State Proximity	Pepperl + Fuchs	NJ4-12GM40-E1	NPN Sinking / 200 mA max. Current / 10-60 VDC
NS – Solid State Proximity	Pepperl + Fuchs	NJ4-12GM40-E2	PNP Sourcing / 200 mA max. Current / 10-60 VDC
NT – Solid State Proximity	Pepperl + Fuchs	NJ4-12GK40-E2	NPN Sourcing / 200 mA max. Current / 10-60 VDC
N9 – Solid State Proximity	Pepperl + Fuchs	NBB3-V3-Z4	NPN Sourcing/ 100 mA max. Current / 5-60 VDC
FZ – AS-I Bus Card	31VDC 28 mA	NJ4-12GK40-E2	NPN Sourcing / 200 mA max. Current / 10-60 VDC
N9 – Solid State Proximity	Pepperl + Fuchs	NBB3-V3-Z4	NPN Sourcing/ 100 mA max. Current / 5-60 VDC
FN – DeviceNet Controller Card, 4 in / 2 out with (2) type P4 switches			
P1 – Inductive Sensor	Pepper + Fuchs	NCB2-12GM40-Z0	20-250V AC/DC NO 2-Wire
F1– Inductive Sensor	IFM	IN5129	10-36 VDC 3 wire
F8 – Inductive Sensor	IFM	IN0081	20-250 AC/DC NO, 350 mA/100 mA w/LED
FL – Inductive Sensor	IFM	IS5026	5-26 VDC 2 wire
NJ – Effector type	IFM	IN-2002-ABOA	20-250V AC/DC NO 2-Wire

4.2 Analog Feedback Option Specifications

Options T, D, E, S - 4-20 mA Transmitter

Voltage Supply: 6-30 VAC
Impedance: 300 Ohms at 20 mA

Options A, B, C - Potentiometer Output
Maximum Load: 1 Watt

Enclosure Ratings
NEMA 4, 4x, 7, and 9
IP67(CSA only) IP65 (ATEX)

Proximity / Solid State Switch Options
Explosion-Proof (CSA)
Class I, Division 1, Groups C and D
Class I, Division 2 Groups A, B, C and D T3
Class II, Divisions 1, Groups E, F and G
Class II, Division 2, Groups F and G
Class III (CSA only)

NOTE: When using a sealed proximity switch (P4, P5, PP) in North American Division 2 applications, a sealing fitting is not required.

5 Hazardous Location Approvals

All Switch Options
Flame-proof

ATEX(SIRA 06ATEX 3392X)
II 2 G Ex d IIB T5
II 2 D Ex tD A21 IP 65
T5 @ -20°C ≤ Tamb ≤ +55°C
EN 60079-0:2004
EN 60079-1:2004
EN 61241-0:2006
EN 61241-1:2004

IECEx
Ex d IIB T5
Ex tD A21 IP 65
T5 @ -20°C ≤ Tamb ≤ +55°C
IEC 60079-0:2004 (Ed.4)
IEC 60079-1:2003 (Ed.5)
IEC 61241-0:2004 (Ed.1)
IEC 61241-1:2004 (Ed.1)

InMetro
BR Ex d IIB T5
T5 @ -20°C ≤ Tamb ≤ +55°C

Mechanical Switch Options
Explosion-Proof (CSA)
Class I, Divisions 1, Groups C and D
Class II, Divisions 1, Groups E, F and G
Class II, Division 2, Groups F and G
Class III (CSA only)
FM U.S. Canada Intrinsically Safe Switch Options
Switch Type: MG, PE, PT, P4, N8, NQ, NP
Class I,II,II Division 1 Groups A, B, C, D, E, F, G T5

6 Product Nomenclature

A = Brand sticker

Blank		Worcester Controls
A	-	Worcester Controls
I	-	Inline Industries
V	-	Valtek
T	-	Texas Electronic Resource
P	-	Worcester Controls
L	-	Limitorque
W	-	Worcester
U	-	UC = Worcester Controls

B = Shaft

D	-	Double 'D' Shaft 1/4"
N	-	NAMUR VDI/VDE 3845 Shaft
G	-	Low profile shaft
T	-	Turnex for NAF

C = Connections (cable entry)

XCL	-	Aluminum Housing, Explosion proof / Flame-proof, 2 x 3/4" NPT
XML	-	Aluminum Housing, Explosion proof / Flame-proof, 2 x M25

D = Indicator option

1	-	Flat Top Cover without indicator
U	-	Standard Ultradome (Green / Red)
3	-	Four Window Ultradome
C	-	90' 3-Way Ultradome
D	-	180' 3-Way Ultradome
E	-	180' 3-Way Center Blocked Ultra-dome
F	-	120' Thru / Divert Ultradome
H	-	Black / Yellow Ultradome
K	-	Green / Red with Ektar Ultradome
R	-	Reverse - Red = Open / Green = Close Ultradome
W	-	White (=closed) / Blue (=open) Ultradome
X	-	Three Position Type 6 White (=closed) / Blue (=open) Ultradome

E = Qty of switches

0	-	0 switches
1	-	1 switch
2	-	2 switches
4	-	4 switches

F = Switch options (qty of switches)

			0	1x	2x	4x
00	-	No Switches (empty housing)		■	■	■
M1	-	SPDT Mechanical switches 250VAC 10A	■			
MA	-	SPDT Mechanical with Cams for 3-Position Control	■	■		■
MD	-	DPDT Mechanical with Cams for DA 3-Position w/ Indication	■	■	■	
MS	-	DPDT Mechanical with Cams for SR 3-Position w/ Indication	■	■	■	
MC	-	SPDT Mechanical - Construction for 250' F	■			
MG	-	SPDT Mechanical - Gold Contacts	■			
M3	-	DPDT Mechanical - Cherry	■			
MB	-	DPDT Mechanical - Licon	■			
F1	-	IFM IN5129 10-36VDC 3-Wire (G=14 only)	■	■		
F8	-	IFM IN0081, 20-250 AC/DC, NO, 350mA/100mA w/LED (G=14 only)	■	■		
FL	-	IFM IS5026, 5-26 VDC 2-wire (G=14 only)	■	■		
P1	-	P&F NCB2-12GM40-Z0 (2-Wire NO, N/A with G=19)	■			
P4	-	SPST Proximity	■			
P5	-	SPDT Proximity	■			
PE	-	Sabre SPDT Proximity	■			
PP	-	Phazer II SPDT Proximity	■			
PT	-	Phazer II BRS SPST Proximity	■			
N8	-	P&F NJ2 V3 N (Namur)	■			
N9	-	P&F NBB3-V3-Z4	■			
NQ	-	P&F NJ4-12GK-N (Namur)	■			■
NR	-	P&F NJ4-12GM40-E1 (3-Wire NPN NO)	■			■
NS	-	P&F NJ4-12GM40-E2 (3-Wire PNP NO)	■			■
NT	-	P&F NJ4-12GK40-E2 (3-Wire PNP NO)	■			■
NP	-	P&F SJ3.5-N (NAMUR)	■			
NJ	-	Efector Type IN-2002-ABOA (G=14 only)	■			
FN	-	DeviceNet Controller Card, 4 in / 2 out, with (2) type P4 switches (N/A with G=19)	■	■		■
FZ	-	AS-i 2:1 Controller card 2x P4 switches	■	■		■

G = Certificate

14	-	General Purpose
18	-	cCSAus Cl.I, Div1, Gr.CD / Cl.II, Div1, Gr.EFG, Cl.III. ATEX II 2G, Ex d IIB/ Ex tD

F = Switch options (qty of switches)			**0**	**1x**	**2x**	**4x**
19	-	ATEX II 2 G EEx d IIB T4-T6, II 2 D Ex tD A21 IP65				
25	-	IEC Ex approval Ex d IIB T4-T6, II 2 D Ex tD A21 IP65				
26	-	Inmetro BR Ex d IIB T5				
27	-	cCSAus IS class I, II, III Div1, Gr.AB-CDEFG T5				
28	-	cCSAus Cl.I, Div2, Gr. A,BC&D.				
30	-	Kosha Ex d IIB T5				
M1	-	Metal plate cCSAus Cl.I, Div2, Gr. A,BC&D.				
M2	-	Metal plate cCSAus Cl.I, Div1, Gr.CD / Cl.II, Div1, Gr.EFG, Cl.III.				
M3	-	Metal plate ATEX II 2 G EEx d IIB T5				
H = Analog Output *						
0	-	None				
T	-	4-20 mA transmitter (F= 00, M1, MG & N8 only)				
D	-	180 deg 4-20 mA transmitter (F= 00, M1, MG & N8 only)				
A	-	0-1k Ohm Pot				
B	-	0-5k Ohm Pot				
C	-	0-10k Ohm Pot				
I = Wiring options						
0	-	None				
1	-	Brad Harrison Connectors - 3 pins				
2	-	Brad Harrison Connectors - 5 pins				
3	-	Brad Harrison Connectors - 7 pins				
H	-	Heavy Duty Terminal Block (Max 8 contact points)				
P	-	Sealed/Potted Leads**				
R	-	Westinghouse special				
J = Minimun extra terminals						
2	-	2 (Standard***)				
4	-	4 (Optional)				
6	-	6 (Optional, not possible for all switch options)				
8	-	8 (Optional, not possible for all switch options)				
K = Accessories						
0	-	None				
L	-	Cover bolts lubricated with grease				
N	-	No Silicone				
P	-	180' pot (for analog options: A, B, C)				
V	-	Viton O-rings				

L = Housing/Surface treatment

0	-	Black Polyester Powdercoat	
E	-	White Epoxy Coated	
W	-	White Epolon II	

Example:

P	**N**	**XCL**	**U**	**2**	**M1**	**-**	**18**	**-**	**0**	**0**	**2**	**0**	**0**

*Transmitter option available for switch options 00, M1, MG, N8 only, maximum number of switch elements is (2)

**When ordering potted leads, specify the conduit (left or right), number of leads, length, and color of wires

***Some models have more than (2) open terminal locations open as standard. Consult factory for details.

No possible combination/option

NOTES:

1. MA switch element must be ordered with qty. (2) switch elements. MD and MS switch elements must be ordered with qty. (4) switch element.
2. Certifications:
   Valid certification codes for Mechanical Switches (options M1, MA, MD, MS, MC, MG, M3 and MB) include -14, -18, -19, -25, -M1. Valid certification codes for Proximity Switches (options P4, P5, PE, PP, PL, PT, N8, N9, NQ, NR, NS, NJ and NP include -14, -18, -19, -25, -M2. Valid certification codes for Analog Output (options T, D, A, B, D) include -14,-18,-19,-24, -M1.
3. Transmitter option available for switch options 00,M1,MG, N8 only, maximum number of switch elements is (2).
4. When Ordering potted leads, specify the conduit (left or right), number of leads, length, and color of wires.
5. Some models have more than (2) open terminal locations open as standards. Consult factory for details.
6. Switch option FN(Device Net) is not approved for ATEX or IECEx.
7. Valid switch options for Intrinsically Safe (-27 code) are MG, PE, PT, P4, N8, NQ, NP.
8. Heavy Duty Terminal blocks only available for two (2) SPST or two (2) SPDT type switches maximum. (8 terminal points maximum).

Example:

PNXCLU2M1-18-00200 = Worcester Controls brand, NAMUR shaft, XCL, Ultradome indicator, (2) SPDT mechanical switches CSA and ATEX certifications.

7 Materials

Part	Materials
Housing/Cover	Aluminum w/ Dichromate & Polyester Powdercoat
Shaft	Stainless Steel
Cams/Splines	Nylon
UltraDome and Rotor	Polycarbonate
Terminal Block	Nylon – Buchanan TBS Series
Internal Brackets	Stainless Steel or Plated Steel
All Internal Fasteners	Stainless Steel or Plated Steel
All External Fasteners	Stainless Steel
UltraDome	Lexan or Ektar™
Rotor	Polycarbonate

⚠ **CAUTION:** If the equipment is likely to come into contact with corrosive substances, then it is the responsibility of the user to ensure that the type of protection provided by the equipment is not compromised.

8 Dimensions

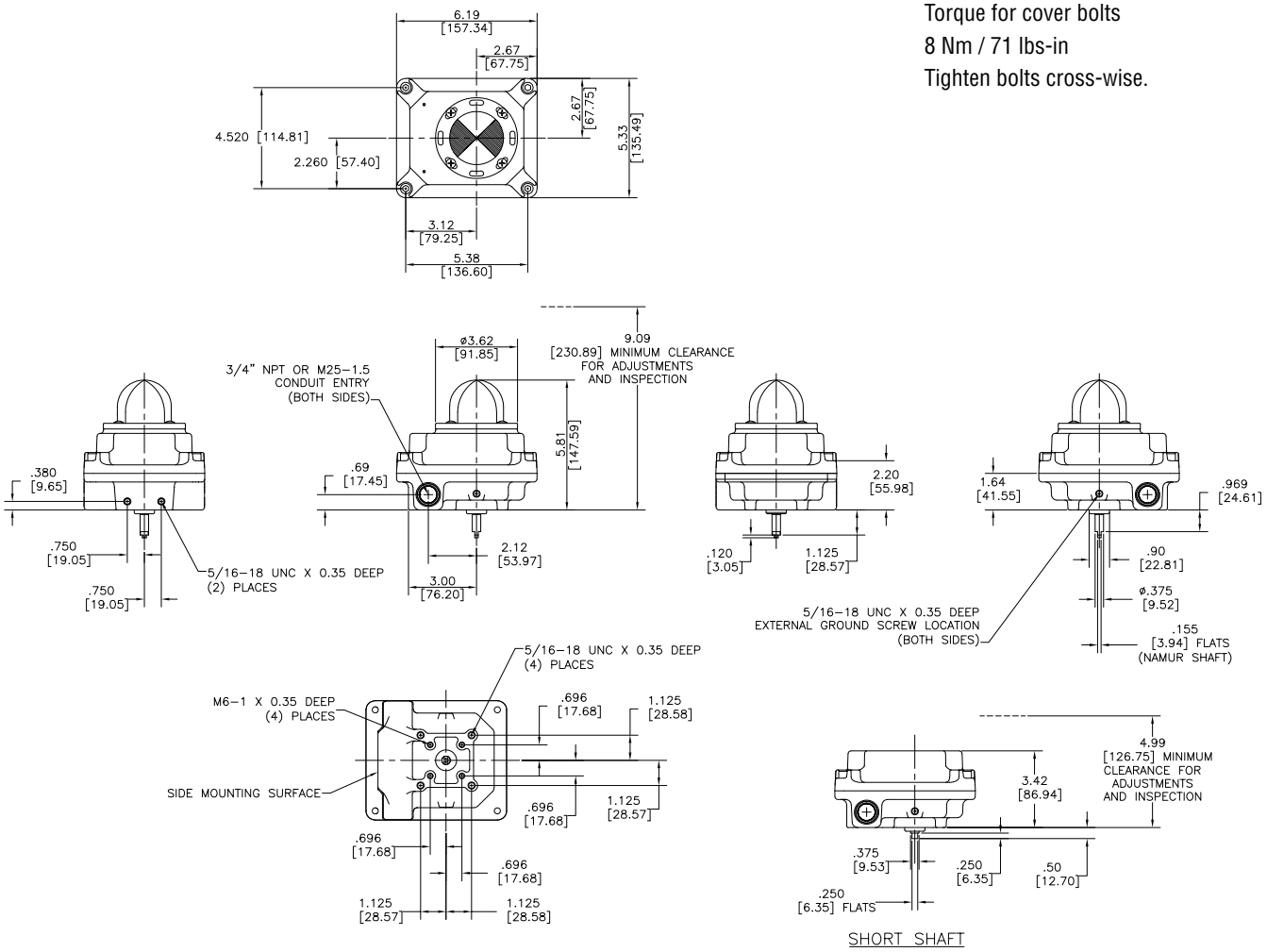
8.1 Max Safe Gaps

The maximum constructional gap is less than that required by Table 1 of IEC/EN 60079-1:2003/2004 as detailed below.

Flamepath	Maximum Gap (mm)	Comment
Cover and base	0.058 (0,038 for CSA)	Flanged joint
Operating rod and cover bushing	0.088	Cylinderical spigot joint
Cover and bushing	0.00	Interference fit
Operating rod and base bushing	0.088	Cylinderical spigot joint
Base and bushing	0.00	Interference fit

8.2 Drawings

Torque for cover bolts
8 Nm / 71 lbs-in
Tighten bolts cross-wise.



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